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INTRAVASCULAR VENTRICULOCORONARY ARTERY BYPASS DELIVERY MODALITIES

TECHNICAL FIELD

The present invention relates generally to a method for performing a coronary artery bypass procedure and, more particularly, to a method for performing an intravascular coronary artery bypass procedure providing a direct flow path from a heart chamber to the coronary artery.

BACKGROUND

Coronary artery disease (e.g., the accumulation of arteriosclerotic plaque within a coronary artery) is the leading cause of premature death in industrialized societies. Modern medical science has developed several procedures for treating coronary artery disease. For example, one method for treating coronary artery disease involves harvesting a saphenous vein or other venous or arterial conduit from elsewhere in the body, or using an artificial conduit, such as one made of expanded polytetrafluoroethylene (ePTFE) tubing, and connecting this conduit as a bypass graft from a viable artery or a chamber of the heart to the coronary artery downstream of the blockage or narrowing. While such treatments are well-established medical procedures, they are not without shortcomings. For example, the number of bypass conduits available for harvesting from the patient is limited. Furthermore, these procedures typically cause significant tissue damage to the patient at the harvest site as well as at the patient's chest.

In addition to the bypass procedures mentioned above, several intravascular methods exist that allow surgeons to re-open the diseased artery, such as, angioplasty or atherectomy. Angioplasty involves the intravascular introduction of a balloon-equipped catheter into the diseased blood vessel. Once the catheter is guided to the appropriate location, the balloon is inflated compressing the arteriosclerotic plaque against the wall of the blood vessel. Atherectomy results in

the physical desolution of plaque within the diseased blood vessel using a catheter equipped with a removal tool (e.g., a cutting blade or high-speed rotating tip). While these procedures are less-invasive and are effective in treating the diseased blood vessel, there are shortcomings with these procedures. For example, many existing intravascular procedures do not allow the surgeon to bypass the obstruction. Instead, separate catheter devices are typically inserted in the patient to achieve, for example, revascularization of the blood vessel at a location downstream from the obstruction.

Improvements in intravascular procedures used for treating coronary artery disease are, therefore, sought.

SUMMARY

The present invention relates generally to a method for performing a coronary artery bypass procedure. More particularly, the present invention relates to a method for performing an intravascular coronary artery bypass procedure providing a direct flow path from a heart chamber to the coronary artery. The method of the present disclosure is preferably utilized where the patient's vascular system is used as a conduit for accessing or reaching a desired location within the patient's body.

In one aspect of the disclosure, a method for supplementing a flow of blood to a portion of the cardiovascular system of a patient is disclosed. The method can comprise inserting a catheter device into the vasculature of the patient and advancing the catheter device to a first location within a first coronary vessel within the cardiovascular system; guiding the catheter device through an interstitial passageway formed between the first location and a second location within a second coronary vessel that is distal to an obstruction in the second coronary vessel; forming a blood flow path from a heart chamber directly to the second coronary vessel; and occluding the interstitial passageway between the first coronary vessel and the second coronary vessel to prevent blood flow through the interstitial passageway. In this aspect, the second coronary vessel is a coronary artery, such as,

the left anterior descending coronary artery. Similarly, the first coronary vessel is a coronary vein proximate to the coronary artery, such as, the great cardiac vein.

Further to this aspect, forming a blood flow path from the heart chamber directly to the second coronary vessel can include placing a conduit in a heart wall between the heart chamber and the second coronary vessel. Moreover, placing a conduit in a heart wall between the heart chamber and the second coronary vessel can include placing a conduit in a septal passageway extending into the heart wall between the heart chamber and the second coronary vessel.

Still further in this aspect, the interstitial passageway is formed through a wall of the first coronary vessel and through a wall of the second coronary vessel between the first and second locations. In so doing, occluding the interstitial passageway can include deploying an embolization substance at the wall of the first vessel and at the wall of the second vessel. Alternatively, occluding the interstitial passageway includes deploying an embolization device within the interstitial passageway.

In another aspect of the invention, the method can comprise inserting a catheter device into the vasculature of the patient and advancing the catheter device to a first location within a first coronary vessel within the cardiovascular system; guiding the catheter device through a first interstitial passageway formed between the first location and a second location within a second coronary vessel within the cardiovascular system; advancing the catheter device to a third location within the second coronary vessel; guiding the catheter device through a second interstitial passageway formed between the third location and a fourth location within the first coronary vessel that is distal to an obstruction in the first coronary vessel; forming a blood flow path from a heart chamber directly to the first coronary vessel; and occluding the first and second interstitial passageways between the first coronary vessel and the second coronary vessel to prevent blood flow through either of the first or second passageways. In this aspect, the first coronary vessel is a coronary artery, such as, the left anterior descending coronary artery. Similarly, the second coronary vessel is a coronary vein proximate to the coronary artery, such as, the great cardiac vein.

Further to this aspect, forming a blood flow path from the heart chamber directly to the first coronary vessel can include placing a conduit in a heart wall between the heart chamber and the first coronary vessel. Moreover, placing a conduit in a heart wall between the heart chamber and the first coronary vessel can include placing a conduit in a septal passageway extending into the heart wall between the heart chamber and the first coronary vessel.

Still further in this aspect, the first interstitial passageway is formed through a wall of the first coronary vessel and through a wall of the second coronary vessel between the first and second locations. Likewise, the second interstitial passageway is formed through a wall of the second coronary vessel and through a wall of the first coronary vessel between the third and fourth locations. In so doing, occluding the first and second interstitial passageways can include deploying an embolization substance at the wall of the first coronary vessel and at the wall of the second coronary vessel at the first interstitial passageway; and deploying an embolization substance at the wall of the first coronary vessel and at the wall of the second coronary vessel at the second interstitial passageway. Alternatively, occluding the first and second interstitial passageways can include deploying an embolization device within each of the first and second passageways.

In still another aspect of the invention, the method can comprise inserting a catheter device into the vasculature of the patient and advancing the catheter device to a first location within a coronary vessel within the cardiovascular system that is proximate to an obstruction within the coronary vessel; advancing the catheter device through the obstruction to a second position distal to the obstruction; guiding the catheter device through an interstitial passageway extending into a heart wall between a heart chamber and the coronary vessel; and placing a conduit in the interstitial passageway extending into the heart wall between the heart chamber and the coronary vessel. In this aspect, the coronary vessel can be a coronary artery.

Further in this aspect, the method can further comprise distending the obstruction within the coronary vessel. Accordingly, distending the obstruction within the coronary vessel can include inflating a balloon at the obstruction within the coronary vessel. Moreover, the interstitial passageway can include a septal

passageway extending into the heart wall between the heart chamber and the coronary vessel.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. **1** is a high-level schematic illustration of an intravascular catheter being advanced throughout a patient's vascular system in accordance with the principles of the present disclosure;

FIGS. **2A-2G** depict one possible embodiment of the method for performing an intravascular coronary artery bypass procedure in accordance with the principles of the present disclosure;

FIGS. **3A-3E** depict a second possible embodiment of the method for performing an intravascular coronary artery bypass procedure in accordance with the principles of the present disclosure; and

FIGS. **4A-4E** depict a third possible embodiment of the method for performing an intravascular coronary artery bypass procedure in accordance with the principles of the present disclosure;

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

Various embodiments of the present invention will be described in detail with reference to the drawings, wherein like reference numerals represent like parts and assemblies throughout the several views. Reference to various

embodiments does not limit the scope of the present invention, which is limited only by the scope of the claims attached hereto.

The following discussion is intended to provide a brief, general description of a method of intravascular treatment of a diseased blood vessel within a patient's vascular system. The method of the present disclosure may be implemented during any intravascular surgical procedure where it is desirous to utilize the patient's vascular system as a conduit for accessing or reaching a desired location within the patient's body to effect an appropriate medical intervention.

As will become apparent from the discussion below in connection with the accompanying drawings, the present disclosure has particularized applicability to the treatment of diseased blood vessels within the patient's cardiovascular system. However, it will be appreciated by those having skill in the art that the present disclosure is not limited to the specific embodiments discussed below. Rather, the present disclosure has general applicability to situations where it is desirable to treat a diseased blood vessel by utilizing the patient's vascular system as a conduit for accessing or reaching a desired location within the patient's body.

Moreover, in the most preferred embodiments, the left ventricle is the chamber of the heart utilized. There are two reasons for this selection. First, the left ventricle normally provides blood to the coronary arteries, because it pumps blood into the aorta from which the coronary arteries branch. Therefore, the magnitude of the blood pressure peak generated by the left ventricle is most similar to the blood pressure peak the proximal coronary artery would normally experience. Second, the blood which flows into the left ventricle is returning from the lungs. In the lungs, the blood acquires oxygen and loses carbon dioxide. Thus, the blood available by shunting from the chambers of the left side of the heart will have a higher oxygen and lower carbon dioxide content than blood within the right-side chambers.

Now referring to FIG. **1**, an exemplary intravascular coronary artery bypass procedure will be described. As described above, such procedures allow surgeons to effectively treat a diseased blood vessel with minimal invasiveness to the patient **100** being treated. The phrase "diseased blood vessel" is generally meant to include any blood vessel having a diminished blood flow capacity due to, for

example, a build-up or accumulation of arteriosclerotic plaque within the vessel. Moreover, because these procedures are performed using catheters that are introduced remotely, normal tissue injury associated with other procedures can be minimized.

As shown in FIG. **1**, an intracoronary catheter device **102** is inserted into a patient **100** via an incision. In the illustrated embodiment, the catheter device **102** can be a guide catheter capable of atraumatically advancing through the patient's **100** arterial system. Alternatively, as is commonly understood in the art, the catheter device **102** can include (or used in conjunction with) any catheter device capable of effecting a desired medical or therapeutic intervention. For example, the catheter device **102** can be equipped with (or used in conjunction with separate catheters that are equipped with) ablation devices, endoscopic devices, surgical tools, such as, needles, cannula, catheter scissors, graspers, or biopsy devices, and energy delivery devices, such as, laser fibers, bipolar and monopolar radio frequency ("RF") conductors, microwave antennae, radiation delivery devices, and thermal delivery devices.

As shown in FIG. **1**, the catheter **102** can be inserted via an incision located at or near the groin **104** and advanced through the patient's **100** arterial system towards the diseased blood vessel. While many paths through the patient's **100** arterial system are contemplated, as shown in the embodiment illustrated in FIG. **1**, the catheter **102** can be advanced towards the diseased blood vessel within the patient's cardiovascular **111** system via the femoral artery **106**. Through continued advancement within the descending aorta **108** and the ascending aorta **110**, the patient's **100** cardiovascular system **111** is entered. The catheter **102** is advanced through the cardiovascular system **111** until it is positioned within the diseased coronary blood vessel proximate to the treatment zone or diseased portion **113** of the cardiovascular system **111**.

As discussed above, the present disclosure provides a method for utilizing the patient's **100** vascular system as a conduit for accessing or reaching to a desired location with the patient's **100** body. The desired location within the patient's **100** vascular system can be determined through standard radiographic

techniques well-known to those having ordinary skill in the art. Once at the desired location (e.g., the treatment zone or diseased portion **113**), a surgeon can treat the diseased coronary blood vessel by revascularizing the diseased blood vessel. In particular, the method of the present disclosure provides for the transmycardial revascularization of the diseased blood vessel by establishing a channel leading from a chamber of the patient's **100** heart into the diseased blood vessel. This will be described in greater detail below.

Now referring to FIGS. **2A-2G**, the catheter device **102** is advanced through the patient's **100** (FIG. **1**) arterial system into the cardiovascular system **111** (FIG. **1**). As is commonly understood, the catheter device **102** can be guided through the patient's **100** vascular system over a guide wire **103**. The guide wire **103** permits the atraumatic advancement of the catheter **102** and/or additional instrumentation (e.g., ablation devices, etc.) into the diseased coronary vessel. As shown in FIG. **2A**, the catheter device **102** is advanced into the cardiovascular system **111** and positioned within a first coronary blood vessel **112**. In the illustrated embodiment, the first blood vessel **112** is a diseased coronary blood vessel, such as, a diseased coronary artery. More particularly, the first blood vessel **112** can be the Left Anterior Descending coronary artery. As is commonly understood, the first blood vessel **112** (e.g., the coronary artery) proceeds along the surface of the heart proximate to or adjacent to a second coronary blood vessel **116**. In the illustrated embodiment, the second coronary blood vessel **116** is a coronary vein, such as, the Great Cardiac Vein. Due to the arrangement and/or proximity of the first blood vessel **112** (e.g., the coronary artery) with respect to the second blood vessel **116** (e.g., the coronary vein), either of two can be used as a conduit for accessing or reaching a desired location within the other.

The wall **114** of the first blood vessel **112** (e.g., the coronary artery) defines a lumen **115** that serves to deliver oxygenated blood to the patient's **100** heart muscle (e.g., the myocardium **152**). The blood flow through the first blood vessel **112** flows in the direction of arrow **A**. Moreover, as shown throughout FIGS. **2A-2G**, arteriosclerotic plaque has accumulated at the treatment zone **113** to form an obstruction **122**. The obstruction **122** acts to reduce the volume of blood flow

through the first blood vessel **112** (e.g., the coronary artery) along the direction of arrow **A**. Similarly, the wall **118** of the second blood vessel **116** (e.g., the coronary vein) defines a lumen **119** that serves to return oxygen depleted blood to the right atrium. The blood flow through the second blood vessel **116** flows in the direction of arrow **A'**. While the illustrated embodiments show the first and second blood vessels **112, 116** being separated, it should be understood that this is for illustrative purposes and that such a separation may not exist. Instead, for example, the wall **114** of the first coronary blood vessel **112** may be immediately adjacent to or in contact with the wall **118** of the second coronary blood vessel **116**.

In accordance with the method of the present disclosure, the catheter device **102** can be advanced within the patient's **100** vascular system to a first location **130** within the first blood vessel **112** (e.g., the coronary artery). In the illustrated embodiment, the first location **130** is situated proximate to the obstruction **122**. As discussed above, it is often desirous to treat the diseased blood vessel (e.g., via revascularization or any other suitable technique or medical intervention) by situating the catheter **102** downstream or distal to the obstruction **122**. In one possible embodiment, this can be accomplished by diverting the catheter **102** around the obstruction **122**. In particular, as will be discussed in connection with FIGS. **2B-2G**, the catheter **102** can be diverted from within the first blood vessel **112** into the second blood vessel **116**, thereby, allowing the catheter **102** to be advanced to a location distal to the obstruction **122** without advancing through the obstruction **122**. However, one skilled in the art will readily appreciate that the catheter **102** can be situated downstream or distal to the obstruction **122** by advancing the catheter **102** through the obstruction **122** (as will be described in connection with FIGS. **4A-4E**).

In one possible embodiment, the catheter **102** can be guided to a location distal to the obstruction **122** by being diverted from within the first coronary vessel **112** (e.g., the coronary artery) into the second coronary blood vessel **116** (e.g., the coronary vein). To accomplish this, as shown in FIG. **2B**, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) an ablation device, for example, an ablation tip (not shown) capable of ablating or otherwise creating a first interstitial passageway or channel **140** between

the first coronary vessel **112** and the second coronary vessel **116**. Ablation devices are well-known in the art and typically operate using any suitable power source, such as, laser, radio frequency, or any other similar power source. Moreover, as is commonly understood in the art, power to the ablating tip (not shown) can be synchronized such that the ablation occurs at a recurring aspect of the cardiac cycle. The first interstitial passageway **140** provides a path of communication between the first coronary vessel **112** and the second coronary vessel **116**. In one possible embodiment, the first interstitial passageway **140** is formed through the wall **114** of the first coronary vessel **112** and through the wall **118** of the second coronary vessel **116** between the first location **130** and a second location **132** within the second coronary vessel **116**. Once the first interstitial passageway **140** has been formed, the catheter device **102** can be guided over the guide wire **103** into the second coronary vessel **116**.

Once the catheter device **102** is positioned within the second coronary vessel **116** (e.g., the coronary vein), the catheter **102** can be guided through the lumen **119** as shown in FIG. **2C** to a third location **134** within the second coronary vessel **116**. In the illustrated embodiment, the third location **134** is situated at a location downstream or distal to the obstruction **122** within the first coronary vessel **112** (e.g., the coronary artery). Once at the third location **134**, the catheter **102** can be diverted from within the second coronary blood vessel **116** such that it returns to the first coronary vessel **112**. In particular, as shown in FIG. **2D** and as discussed above, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) an ablation device, for example, an ablation tip (not shown) capable of ablating or otherwise creating a second interstitial passageway or channel **142** between the second coronary vessel **116** and the first coronary vessel **112**. The second interstitial passageway **142** provides a path of communication between the second coronary vessel **116** and the first coronary vessel **112** distal to the obstruction **122**. In one possible embodiment, the second interstitial passageway **142** is formed through the wall **118** of the second coronary vessel **116** and through the wall **114** of the first coronary vessel **112** between the third location **134** and a fourth location **136** within the first coronary

vessel **112**. Once the second interstitial passageway **142** has been formed, the catheter device **102** can be guided over the guide wire **103** into the first coronary vessel **112**.

While the first and second interstitial passageways **140, 142** are illustrated as having been created substantially perpendicular to the first and second coronary blood vessels **112, 116**, it will be appreciated by those having skill in the art that the first and second interstitial passageways **140, 142** can be formed at any angle suitable for providing a path of communication between the first and second coronary vessels **112, 116**, thereby, allowing the catheter device **102** to be diverted into or out of either of the coronary blood vessels **112, 116**.

As shown in FIG. **2D**, the fourth location **136** is situated downstream or distal to the obstruction **122**. Accordingly, the amount of blood flow through the first coronary vessel **112** (e.g., the coronary artery) is reduced due to the obstruction **122**. Several methods exist that allow surgeons to treat the diseased blood vessel by supplementing the blood flow through the first coronary vessel **112**. In particular, the method of the present disclosure treats the diseased blood vessel by creating a channel that leads directly from a chamber **150** of the heart through the myocardium **152**. Various methods and devices for transmyocardial revascularization have been described in U.S. Patent No. 5,944,019 to Knudson et al., entitled "CLOSED CHEST CORONARY BYPASS," the entire disclosure of which is, hereby, incorporated by reference.

For example, as shown in FIG. **2E**, once the catheter **102** is situated at the fourth location **136** within the first coronary vessel **112** (e.g., the coronary artery), a channel **143** can be established between the heart chamber **150** and the first coronary vessel **112**. In particular, as shown in FIG. **2E** and as discussed above, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) an ablation device, for example, an ablation tip (not shown) capable of ablating or otherwise creating the channel **143** between the first coronary vessel **112** and the heart chamber **150**.

Once the channel **143** is formed, a transmyocardial implant **146** (e.g., a conduit) can be deployed within the channel **143**. In certain embodiments, the

transmyocardial implant **146** can include a tubular reinforcing structure (e.g., a mesh and/or coild tube, a tube defined by a plurality of circumferential and axial struts/supports, etc.) that is expandable from an undeployed state to a deployed state. In the undeployed state, the transmyocardial implant **146** has a reduce diameter sized for allowing the implant to be directed through the patient's **100** vasculature. In the deployed state, the implant has an expanded diameter sized for allowing the transmyocardial implant **146** to be securely held within the channel **143**. The reinforcing structure of the transmyocardial implant **146** can be expanded by known techniques (e.g., the structure can be balloon expandable or self expanding). Additionally, some embodiments of the transmyocardial implant **146** can include a liner for preventing thrombosis as shown in U.S. patent application serial no. 09/141,284, filed 27 August 1999, the entire disclosure of which is, hereby, incorporated by reference.

During installation, the transmyocardial implant **146** can be positioned within the channel **143** in its undeployed state. Once properly positioned, the transmyocardial implant **146** can be deployed. In it deployed state, the transmyocardial implant **146** is sized to be retained within the formed channel **143**. Moreover, once in place, the transmyocardial implant **146** creates a permanent transmyocardial channel between the heart chamber **150** and the coronary artery **112**.

In addition to deployment of the transmyocardial implant **146**, the first and second interstitial passageways **140, 142** can be blocked or occluded to prevent blood flow through the first and second interstitial passageways **140, 142**. In so doing, the method of the present disclosure restores and/or ensures normal coronary aterial and veinous blood flow. To accomplish this, one or more embolization devices can be deployed within each of the first and second interstitial passageways **140, 142**. In the embodiment illustrated in FIG. **2G**, at least two embolization devices are deployed within each of the first and second interstitial passageways **140, 142**. For example, the embolization devices **138a, 138d** can be deployed within the first coronary vessel **112** (e.g., the coronary artery) proximate to the wall **114**. Similarly, the embolization devices **138b, 138c** can deployed within

the second coronary vessel **116** (e.g., the coronary vein) proximate to the wall **118**. The embolization devices **138a-138d** can include any device and/or material capable preventing blood flow through the first and second interstitial passageways **140, 142**. For example, the embolization devices **138a-138d** can include detachable balloons, coils, strands of coagulation producing material, microfibrillar collagen, collagen sponge, cellulose gel or sponge, such as Gelfoam™, surgical glue, such as, Tissel™ or Genzyme™, special stents, or other similar embolization devices.

An alternative method for treating a diseased blood vessel by utilizing the patient's **100** vascular system as a conduit for accessing or reaching a desired location within the patient's body will now be described in connection with FIGS. **3A-3E**. In this embodiment, the catheter device **102** is advanced through the patient's **100** (FIG. **1**) arterial system into the cardiovascular system **111** (FIG. **1**) and is positioned within the second coronary blood vessel **116** (e.g., the coronary vein). The catheter device **102** can be advanced within the patient's **100** vascular system to a first location **130'** within the second coronary blood vessel **116** (e.g., the coronary vein). In the illustrated embodiment, the first location **130'** is situated at a location downstream or distal to the obstruction **122** within the first coronary vessel **112** (e.g., the coronary artery).

Once at the first location **130'**, the catheter **102** can be diverted from within the second coronary blood vessel **116** such that it returns to the first coronary vessel **112**. In particular, as shown in FIG. **3B** and as discussed above, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) an ablation device, for example, an ablation tip (not shown) capable of ablating or otherwise creating an interstitial passageway or channel **140'** between the second coronary vessel **116** and the first coronary vessel **112**. The second interstitial passageway **142** provides a path of communication between the second coronary vessel **116** and the first coronary vessel **112** distal to the obstruction **122**. In one possible embodiment, the interstitial passageway **140'** is formed through the wall **118** of the second coronary vessel **116** and through the wall **114** of the first coronary vessel **112** between the first location **130'** and a second location **132'** within the first coronary vessel **112**. Once the interstitial passageway **142** has been

formed, the catheter device **102** can be guided over the guide wire **103** into the first coronary vessel **112**.

While the interstitial passageway **140'** is illustrated as having been created substantially perpendicular to the first and second coronary blood vessels **112, 116**, it will be appreciated by those having skill in the art that the interstitial passageway **140'** can be formed at any angle suitable for providing a path of communication between the first and second coronary vessels **112, 116**, thereby, allowing the catheter device **102** to be diverted into or out of either of the coronary blood vessels **112, 116**.

As shown in FIG. **3B**, the second location **132'** is situated downstream or distal to the obstruction **122**. Accordingly, the amount of blood flow through the first coronary vessel **112** (e.g., the coronary artery) is reduced due to the obstruction **122**. As discussed above, several methods exist that allow surgeons to treat the diseased blood vessel by supplementing the blood flow through the first coronary vessel **112**. In particular, the method of the present disclosure treats the diseased blood vessel by creating a channel that leads directly from a chamber **150** of the heart through the myocardium **152**. For example, as shown in FIG. **3C**, once the catheter **102** is situated at the second location **132'** within the first coronary vessel **112** (e.g., the coronary artery), a channel **143'** can be established between the heart chamber **150** and the first coronary vessel **112**. In particular, as shown in FIG. **3C** and as discussed above, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) an ablation device, for example, an ablation tip (not shown) capable of ablating or otherwise creating the channel **143'** between the first coronary vessel **112** and the heart chamber **150**.

Once the channel **143'** is formed, a transmyocardial implant **146'** (e.g., a conduit) can be deployed within the channel **143'**. In certain embodiments, the transmyocardial implant **146'** can include a tubular reinforcing structure (e.g., a mesh and/or coild tube, a tube defined by a plurality of circumferential and axial struts/supports, etc.) that is expandable from an undeployed state to a deployed state. In the undeployed state, the transmyocardial implant **146'** has a reduce diameter sized for allowing the implant to be directed through the patient's **100**

vasculature. In the deployed state, the implant has an expanded diameter sized for allowing the transmyocardial implant **146'** to be securely held within the channel **143'**. The reinforcing structure of the transmyocardial implant **146'** can be expanded by known techniques (e.g., the structure can be balloon expandable or self expanding) and can include a liner for preventing thrombosis as discussed above.

During installation, the transmyocardial implant **146'** can be positioned within the channel **143'** in its undeployed state. Once properly positioned, the transmyocardial implant **146'** can be deployed. In it deployed state, the transmyocardial implant **146'** is sized to be retained within the formed channel **143'**. Moreover, once in place, the transmyocardial implant **146'** creates a permanent transmyocardial channel between the heart chamber **150** and the coronary artery **112**.

In addition to deployment of the transmyocardial implant **146'**, the interstitial passageway **140'** can be blocked to restore and/or ensure normal coronary aterial and veinous blood flow. To accomplish this, one or more embolization devices can be deployed within the interstitial passageways **140'**. In the embodiment illustrated in FIG. **3E**, at least two embolization devices are deployed within the interstitial passageway **140'**. For example, the embolization device **138a'** can be deployed within the first coronary vessel **112** (e.g., the coronary artery) proximate to the wall **114**. Similarly, the embolization device **138b'** can be deployed within the second coronary vessel **116** (e.g., the coronary vein) proximate to the wall **118**. The embolization devices **138a'**, **138b'** can include any device and/or material capable preventing blood flow through the interstitial passageway **140'**. For example, the embolization devices **138a'**, **138b'** can include detachable balloons, coils, strands of coagulation producing material, microfibrillar collagen, collagen sponge, cellulose gel or sponge, such as Gelfoam™, surgical glue, such as, Tissel™ or Genzyme™, special stents, or other similar embolization devices.

Still yet another possible method for treating a diseased blood vessel by utilizing the patient's **100** vascular system as a conduit for accessing or reaching a desired location within the patient's body will now be described in connection with FIGS. **4A-4E**. In this embodiment, the catheter device **102** is advanced through the

patient's **100** (FIG. **1**) arterial system into the cardiovascular system **111** (FIG. **1**) and is positioned within the first coronary blood vessel **112** (e.g., the coronary artery). The catheter device **102** can be advanced within the patient's **100** vascular system to a first location **130"** within the first coronary blood vessel **112** (e.g., the coronary vein). In the illustrated embodiment, the first location **130"** is situated proximate to the obstruction **122**. As discussed above, it is often desirous to treat the diseased blood vessel (e.g., via revascularization or any other suitable technique or medical intervention) by situating the catheter **102** downstream or distal to the obstruction **122**. However, in the embodiment illustrated in FIGS. **4A-4E**, the catheter **102** can be positioned at a location downstream or distal to the obstruction **122** by advancing the catheter **102** through the obstruction **122**.

As shown in FIG. **4B**, the guide wire **103** can be advanced through the obstruction **122** to a second location **132"** distal to the obstruction **122**. As shown in FIG. **4C**, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) a balloon or other similar device capable of mechanically compressing the arteriosclerotic plaque against the wall **114** of the first coronary blood vessel **112** as is commonly understood in the art. In so doing, the amount of blood flow through the first coronary blood vessel **112** can be increased. Furthermore, additional medical devices and/or surgical tools can be advanced to the second location **132"** distal to the obstruction **122**.

Once the catheter **102** is situated at the second location **132"** within the first coronary vessel **112** (e.g., the coronary artery), a channel can be established between the heart chamber **150** and the first coronary vessel **112**. In the particular embodiment illustrated in FIGS. **4A-4E**, the catheter device **102** can be directed towards the heart chamber **150** using an existing passageway from the first coronary vessel **112**. For example, the catheter **102** can be directed towards the heart chamber **150** via a septal opening or branch **160**, **162** formed through the wall **114** of the first coronary blood vessel **112**. Alternatively, the catheter **102** can form a channel to the heart chamber **150** without advancing through an existing opening.

In situations where an existing opening is used, such as, the septal branches **160**, **162**, the pathway to the heart chamber **150** must be extended to

establish communication with the heart chamber **150**. For example, as shown in FIG. **4D**, a pathway extension **163** can be formed to complete the path to the heart chamber **150**. To accomplish this, the catheter device **102** can be equipped with (or used in conjunction with a catheter equipped with) an ablation device, for example, an ablation tip (not shown) capable of ablating or otherwise creating the channel the pathway extension **163** between either of the septal branches **160, 162** into the heart chamber **150**. The existing septal branch **162** and the pathway extension **163** combine to define an interstitial passageway or channel **165** between the first coronary vessel **112** and the heart chamber **150**.

As shown in FIG. **4E** and as discussed above, once the channel **165** is formed, a transmyocardial implant **166** can be deployed in the channel **165**. Additionally, a stent forming device **168** can be deployed within the first coronary blood vessel **112** adjacent to the channel **165**. As can be seen in FIG. **4E**, the transmyocardial implant **166** and the stent forming device **168** cooperate to create a permanent transmyocardial channel between the heart chamber **150** and the coronary artery **112**.

The various embodiments described above are provided by way of illustration only and should not be construed to limit the invention. Those skilled in the art will readily recognize the various modifications and changes which may be made to the present invention without strictly following the exemplary embodiments illustrated and described herein, and without departing from the true spirit and scope of the present invention, which is set forth in the following claims.